AW65S2-50B1

IEEE 802.11 a/b/g/n/ac/ax 2T2R+BT5.4+IEEE 802.15.4 Combo Module

Contents

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1. Device Overview

1.1 Features

1.1.1 General Features

➢ 32bit RISC-V MCU for Wi-Fi protocols and host offload
➢ 32bit RISC-V MCU for Bluetooth/IEEE 802.15.4 controller
➢ SDIO device interface compliant with SDIO 3.0 specification
➢ Single 3.3V power supply
➢ High speed UART interface with hardware flow control
➢ Wi-Fi and Bluetooth/IEEE 802.15.4 co-existence
➢ Dedicated antenna for Bluetooth/IEEE 802.15.4
➢ LGA package

1.1.2 Wi-Fi Key Features

➢ IEEE 802.11a/b/g/n/ac/ax compatible WLAN
➢ Supports two spatial streams 2T2R MIMO
➢ Supports 2.4GHz and 5GHz
➢ Supports 20/40/80MHz bandwidth, and 1024-QAM at 2.4G band, 256-QAM at 5G band
➢ Supports downlink MU-MIMO RX
➢ Supports OFDMA RX and TB OFDMA TX
➢ Supports SU/MU RX Beamformee
➢ Supports STBC and LDPC
➢ Supports DFS channels
➢ Supports Wake-on-WLAN with programmable magic packet
➢ Security features:
    - Supports WEP-40/WEP-104, AES/TKIP/CCMP/GCMP
    - Supports WPA/WPA2/WPA3 personal, WPA2/WPA3 enterprise
    - Supports WPS2.0
    - Supports WAPI

1.1.3 Bluetooth Key Features

➢ Supports Bluetooth v5.4 with BLE audio
➢ Supports dual mode BDR/EDR and BLE
➢ Supports LE 1Mbps, LE 2Mbps, and LE coded for Long Range
➢ Supports Bluetooth Class 1 or Class 2 TX output power
➢ Supports dedicated Bluetooth antenna
➢ Supports Bluetooth/Wi-Fi coexistence
➢ Supports LE privacy, DPLE, and LE secure connection
➢ Supports SCO/eSCO and A2DP
➢ Supports LE isochronous channels
➢ Supports HS-UART and PCM interfaces
➢ Supports AFH for interference avoidance
➢ Backward-compatible with previous Bluetooth standards

1.1.4 IEEE 802.15.4 Key Features：

    - Compliant with IEEE 802.15.4–2020; Works in 2.4G, supports OQPSK PHY
    - Supports MAC security
    - Supports Thread 1.3
    - Supports Zigbee 3.0
    - Supports beacon-enabled PAN
    - Supports nonbeacon-enabled PAN
    - Supports three roles: PAN coordinator, coordinator, end device

- Supports HS-UART host interface

1.2 Applications

➢ Tablet Computer
➢ OTT Box
➢ Smart Speak

1.3 Descriptions

The AW65S2-50B1 is an integrated 3-in-1 combo module supporting 2T2R 802.11ax, Bluetooth 5.4, and 802.15.4. The integrated Wi-Fi subsystem is designed to be fully compliant with IEEE 802.11ax standard with backward compatibility with 802.11a/b/g/n/ac and supports both 2.4GHz and 5GHz up to 80MHz bandwidth. Wi-Fi communication with host is through SDIO 3.0 interface. The integrated Bluetooth controller is compliant with Bluetooth 5.4 and Bluetooth Low Energy featuring BLE audio. The modem supports BDR, EDR2/EDR3, LE 1M/LE 2M and LE 2S/LE 8S BLE rates. IEEE 802.15.4 MAC and PHY are supported through the same Bluetooth radio. A high-speed UART interface is designed for the communication between host and both Bluetooth and 802.15.4. The highly integrated solution can support Thread / Zigbee protocol which is based on 802.15.4 and running on host platform. Applications are extended to the new features from STB, TV, SmartSpeaker to border router, IoT bridge, matter controller, etc.

1.4 Functional Block Diagram
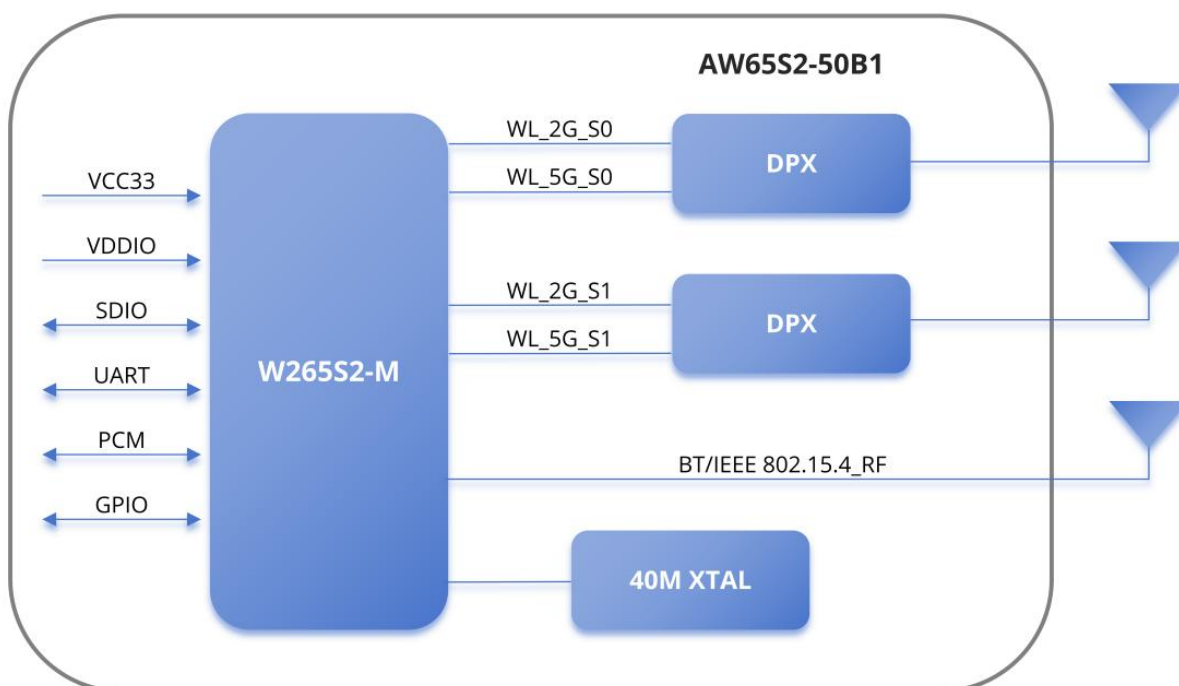
Figure 1. Block Diagram of AW65S2-50B1

2. Pin Configuration and Functions

2.1 Module Pin Diagram
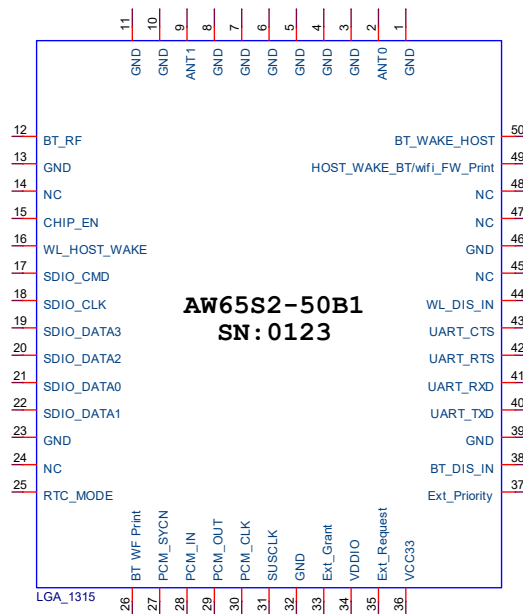
Figure 2. Pin Diagram of AW65S2-50B1

Pin	Name	Description	Pin	Name	Description
1	GND	Ground	26	BT WF Print	BT FW Print
2	ANT0	RF input/output of path WF0 WLAN	27	PCM_SYNC	Bluetooth PCM sync
3	GND	Ground	28	PCM_IN	Bluetooth PCM input
4	GND	Ground	29	PCM_OUT	Bluetooth PCM output
5	GND	Ground	30	PCM_CLK	Bluetooth PCM clock
6	GND	Ground	31	SUSCLK	32K Chip RTC clock input.
7	GND	Ground	32	GND	Ground
8	GND	Ground	33	Ext_Grant	PTA Function. Grant Pin.
9	ANT1	RF input/output of path WF1 WLAN	34	VDDIO	VDDIO power supply
10	GND	Ground	35	Ext_Request	PTA Function. Request Pin.
11	GND	Ground	36	VCC33	3.3V power supply
12	BT_RF	RF input/output of path BT&802.15.4	37	Ext_Priority	PTA Function. Priority Pin.
13	GND	Ground	38	BT_DIS_IN	Bluetooth Chip Enable,Low asserting reset for Bluetooth core.
14	NC	No connect, keep floating	39	GND	Ground
15	CHIP_EN	Chip Enable/Disable Pin	40	UART_TXD	Bluetooth High-Speed UART Data Out
16	WL_HOST_WAKE	WLAN wake up the Host	41	UART_RXD	Bluetooth High-Speed UART Data In
17	SDIO_CMD	SDIO Command Input	42	UART_RTS	Bluetooth High-Speed UART RTS
18	SDIO_CLK	SDIO Clock Input	43	UART_CTS	Bluetooth High-Speed UART CTS
19	SDIO_DATA3	SDIO Data Line 3	44	WL_DIS_IN	WLAN Chip Enable,Low asserting reset for WLAN core.
20	SDIO_DATA2	SDIO Data Line 2	45	NC	No connect, keep floating
21	SDIO_DATA0	SDIO Data Line 0	46	GND	Ground
22	SDIO_DATA1	SDIO Data Line 1	47	NC	No connect, keep floating

23	GND	Ground	48	NC	No connect, keep floating
24	NC	No connect, keep floating	49	HOST_WAKE_BT	Host wake up BT/WIFI FW Print
25	RTC_MODE	CHIP Interface select for ext rtc/inner rtc, 0: ext; 1,inner,Default High.	50	BT_WAKE_HOST	BT wake up Host

2.2 Pin Functions

3. Specifications

Caution! The absolute maximum ratings in the following table indicates voltages levels where permanent physical damage to the device can occur, even if these limits were exceeded for only a brief duration.

3.1 General Characteristics

Category	Descriptions	
Dimension	L*W*H :15.0mm (±0.2mm)*13.0mm (±0.2mm)*2.4mm (±0.2mm)	
Chip-set	W265S2-M	
Standard	IEEE 802.11a/b/g/n/ac/ax+BT 5.4+IEEE802.15.4	
Modulation Type	CCK, OFDM (16 QAM/64 QAM/256 QAM/1024 QAM),OFDMA,OQPSK	
Frequency Band	2400~2500MHz,4900-5845MHz	
Interface	WLAN: SDIO, Bluetooth&IEEE 802.15.4: UART	
Data Security	WEP-40,WEP-104,AES/TKIP/CCMP/GCMP,WPA/WPA2/WPA3, WPS2.0, WAPI	
Transmit Power	2.4G: 11b 1M:21dBm±2dBm 11b 11M: 21dBm±2dBm 11g 6M: 20dBm±2dBm 11g 54M: 17dBm±2dBm 11n HT20 MCS0: 20dBm±2dBm 11n HT20 MCS7: 17dBm±2dBm 11n HT40 MCS0: 20dBm±2dBm 11n HT40 MCS7: 17dBm±2dBm 11ax HE20 MCS0: 20dBm±2dBm 11ax HE20 MCS11: 14dBm±2dBm 11ax HE40 MCS0: 20dBm±2dBm 11ax HE40 MCS11: 13.5dBm±2dBm	5G: 11a 6M: 19dBm±2dBm 11a 54M: 16dBm±2dBm 11n HT20 MCS0: 19dBm±2dBm 11n HT20 MCS7: 15dBm±2dBm 11n HT40 MCS0: 19dBm±2dBm 11n HT40 MCS7: 15dBm±2dBm 11ac VHT20 MCS0: 19dBm±2dBm 11ac VHT20 MCS8: 15dBm±2dBm 11ac VHT40 MCS0: 19dBm±2dBm 11ac VHT40 MCS9: 14dBm±2dBm 11ac VHT80 MCS0: 17dBm±2dBm 11ac VHT80 MCS9: 14dBm±2dBm 11ax HE20 MCS0: 19dBm±2dBm 11ax HE20 MCS9: 14dBm±2dBm 11ax HE40 MCS0: 19dBm±2dBm 11ax HE40 MCS9: 14dBm±2dBm 11ax HE80 MCS0: 19dBm±2dBm 11ax HE80 MCS9: 14dBm±2dBm
Rx Sensitivity	2.4G: 11b 11M:-89dBm 11g 54M: -76dBm 11n HT20 MCS7: -73dBm 11n HT40 MCS7: -71dBm 11ax HE20 MCS11: -64dBm 11ax HE40 MCS11: -62dBm	5G: 11a 54M: -74dBm 11n HT20 MCS7: -72dBm 11n HT40 MCS7: -68dBm 11ac VHT20 MCS8: -70dBm 11ac VHT40 MCS9: -65dBm 11ac VHT80 MCS9: -62dBm 11ax HE20 MCS9: -69dBm 11ax HE40 MCS9: -65dBm

		11ax HE80 MCS9: –62dBm
Data Rate	802.11b [11,5.5,2 and 1Mbps] 802.11g [54,48,36,24,18,12,9&6Mbps] 802.11n HT20:up to 144.4Mbps 802.11n HT40:up to 300Mbps 802.11ac VHT80:up to 866.7Mbps 802.11ax HE20:up to 229.4Mbps 802.11ax HE40:up to 458.8Mbps 802.11ax HE80:up to 960.8Mbps	
Frequency Error	<±20 ppm	
Storage Humidity	Less than 60%	
Antenna	External antenna	
Operating System	Android, Linux	
Operating Voltage	VCC33:3.3V(Typ); VDDIO:1.8V(Typ)	

3.2 Temperature Range

Category	Descriptions
Operating Temperature	0 ℃ ~ 70 ℃
Storage Temperature	–40 ℃ ~ 125℃

3.3 RF Characteristics

3.3.1 Receiver RF Specifications

Parameter	Conditions		Min.	Nom.	Max.	Unit
Receive Input Frequency (2.4GHz)	802.11b/g/n/ax mode		2400	–	2500	MHz
Receiver Sensitivity						
802.11b	1Mbps	FER<8%, Packet size=1,024bytes	–	–	–82	dBm
	2Mbps		–	–	–80	dBm
	5.5Mbps		–	–	–78	dBm
	11Mbps		–	–	–76	dBm
802.11g	6Mbps	PER<10%, Packet size=1,024bytes	–	–	–82	dBm
	9Mbps		–	–	–81	dBm
	12Mbps		–	–	–79	dBm
	18Mbps		–	–	–77	dBm
	24Mbps		–	–	–74	dBm
	36Mbps		–	–	–70	dBm
	48Mbps		–	–	–66	dBm
	54Mbps		–	–	–65	dBm
802.11n (HT20)	MCS0.	PER<10%,	–	–	–82	dBm

	MCS1.	Packet size=4,096bytes	–	–	–79	dBm
	MCS2		–	–	–77	dBm
	MCS3.		–	–	–74	dBm
	MCS4.		–	–	–70	dBm
	MCS5.		–	–	–66	dBm
	MCS6.		–	–	–65	dBm
	MCS7.		–	–	–64	dBm
802.11n (HT40)	MCS0.	PER<10%, Packet size=4,096bytes	–	–	–79	dBm
	MCS1.		–	–	–77	dBm
	MCS2		–	–	–74	dBm
	MCS3.		–	–	–71	dBm
	MCS4.		–	–	–67	dBm
	MCS5.		–	–	–63	dBm
	MCS6.		–	–	–62	dBm
	MCS7.		–	–	–61	dBm
802.11ax (HE20)	MCS0.	PER<10%, Packet size=4,096bytes	–	–	–82	dBm
	MCS1.		–	–	–79	dBm
	MCS2		–	–	–77	dBm
	MCS3.		–	–	–74	dBm
	MCS4.		–	–	–70	dBm
	MCS5.		–	–	–66	dBm
	MCS6.		–	–	–65	dBm
	MCS7.		–	–	–64	dBm
	MCS8.		–	–	–59	dBm
	MCS9.		–	–	–57	dBm
	MCS10.		–	–	–54	dBm
	MCS11.		–	–	–52	dBm
802.11ax (HE40)	MCS0.	PER<10%, Packet size=4,096bytes	–	–	–79	dBm
	MCS1.		–	–	–76	dBm
	MCS2		–	–	–74	dBm
	MCS3.		–	–	–71	dBm
	MCS4.		–	–	–67	dBm
	MCS5.		–	–	–63	dBm
	MCS6.		–	–	–62	dBm
	MCS7.		–	–	–61	dBm
	MCS8.		–	–	–56	dBm
	MCS9.		–	–	–54	dBm
	MCS10.		–	–	–51	dBm
	MCS11.		–	–	–49	dBm
Maximum Input Level						
802.11b	FER<8%		–10	–	–	dBm
802.11g	FER<10%		–20	–	–	dBm
802.11n	FER<10%		–30	–	–	dBm

Parameter	Conditions		Min.	Nom.	Max.	Unit
802.11ax	FER<10%		−20	–	–	dBm

Parameter	Conditions		Min.	Nom.	Max.	Unit
Receive Input Frequency (5 GHz)	802.11a/n/ac/ax mode		4900	–	5845	MHz
Receiver Sensitivity						
802.11a	6Mbps	FER<10%, Packet size=1,024bytes	–	–	−82	dBm
	9Mbps		–	–	−81	dBm
	12Mbps		–	–	−79	dBm
	18Mbps		–	–	−77	dBm
	24Mbps		–	–	−74	dBm
	36Mbps		–	–	−70	dBm
	48Mbps		–	–	−66	dBm
	54Mbps		–	–	−65	dBm
802.11n (HT20)	6Mbps	PER<10%, Packet size=4,096bytes	–	–	−82	dBm
	9Mbps		–	–	−79	dBm
	12Mbps		–	–	−77	dBm
	18Mbps		–	–	−74	dBm
	24Mbps		–	–	−70	dBm
	36Mbps		–	–	−66	dBm
	48Mbps		–	–	−65	dBm
	54Mbps		–	–	−64	dBm
802.11n (HT40)	MCS0.	PER<10%, Packet size=4,096bytes	–	–	−79	dBm
	MCS1.		–	–	−77	dBm
	MCS2		–	–	−74	dBm
	MCS3.		–	–	−71	dBm
	MCS4.		–	–	−67	dBm
	MCS5.		–	–	−63	dBm
	MCS6.		–	–	−62	dBm
	MCS7.		–	–	−61	dBm
802.11ac (VHT80)	MCS0.	PER<10%, Packet size=4,096bytes	–	–	−76	dBm
	MCS1.		–	–	−73	dBm
	MCS2		–	–	−71	dBm
	MCS3.		–	–	−68	dBm
	MCS4.		–	–	−64	dBm
	MCS5.		–	–	−60	dBm
	MCS6.		–	–	−59	dBm
	MCS7.		–	–	−58	dBm
	MCS8.		–	–	−53	dBm
	MCS9.		–	–	−51	dBm
802.11ax (HE80)	MCS0.	PER<10%, Packet size=4,096bytes	–	–	−76	dBm
	MCS1.		–	–	−73	dBm
	MCS2		–	–	−71	dBm
	MCS3.		–	–	−68	dBm

	MCS4.		–	–	–64	dBm
	MCS5.		–	–	–60	dBm
	MCS6.		–	–	–59	dBm
	MCS7.		–	–	–58	dBm
	MCS8.		–	–	–53	dBm
	MCS9.		–	–	–51	dBm
Maximum Input Level						
802.11a	FER<10%		–30	–	–	dBm
802.11n	FER<10%		–30	–	–	dBm
802.11ac	FER<10%		–30	–	–	dBm
802.11ax	FER<10%		–30	–	–	dBm

3.3.2 Transmitter RF Specifications

Parameter	Conditions	Min.	Nom.	Max.	Unit
802.11b/g/n/ax Frequency	**2.4GHz**	2400	–	2500	MHz
Transmit Power					
802.11b	1Mbps	19	21	23	dBm
	11Mbps	19	21	23	dBm
802.11g	6Mbps	18	20	22	dBm
	54Mbps	15	17	19	dBm
802.11n	HT20, MCS0	18	20	22	dBm
	HT20, MCS7	15	17	19	dBm
	HT40, MCS0	18	20	22	dBm
	HT40, MCS7	15	17	19	dBm
802.11ax	HE20,MCS0	18	20	22	dBm
	HE20,MCS11	12	14	16	dBm
	HE40,MCS0	18	20	22	dBm
	HE40,MCS11	11.5	13.5	15.5	dBm
Spectrum Mask					
802.11b	fc–22MHz<f<fc–11MHz&fc+11MHz<f<fc+22MHz	–	–	–30	dBr
	fc–55MHz<f<fc–22MHz&fc+22MHz<f<fc+55MHz	–	–	–50	dBr
802.11g	fc±9MHz	–	–	0	dBr
	fc±11MHz	–	–	–20	dBr
	fc±20MHz	–	–	–28	dBr
	fc±30MHz	–	–	–40	dBr
802.11n	fc±9MHz	–	–	0	dBr
	fc±11MHz	–	–	–20	dBr
	fc±20MHz	–	–	–28	dBr
	fc±30MHz	–	–	–45	dBr
802.11ax (HE20)	fc±9.75MHz	–	–	0	dBr
	fc±10.5MHz	–	–	–20	dBr
	fc±20MHz	–	–	–28	dBr
	fc±30MHz	–	–	–40	dBr
802.11ax (HE40)	fc±19.5MHz	–	–	0	dBr

	fc±20.5MHz		–	–	–20	dBr
	fc±40MHz		–	–	–28	dBr
	fc±60MHz		–	–	–40	dBr
Center Frequency Tolerance						
802.11b/g/n/ax			–20	–	+20	ppm
EVM (Error Vector Magnitude)*						
802.11b	1Mbps		–	–	35	%
	2Mbps		–	–	35	%
	5.5Mbps		–	–	35	%
	11Mbps		–	–	35	%
802.11g	6Mbps		–	–	–5	dB
	9Mbps		–	–	–8	dB
	12Mbps		–	–	–10	dB
	18Mbps		–	–	–13	dB
	24Mbps		–	–	–16	dB
	36Mbps		–	–	–19	dB
	48Mbps		–	–	–22	dB
	54Mbps		–	–	–25	dB
802.11n	MCS0.		–	–	–5	dB
	MCS1.		–	–	–10	dB
	MCS2		–	–	–13	dB
	MCS3.		–	–	–16	dB
	MCS4.		–	–	–19	dB
	MCS5.		–	–	–22	dB
	MCS6.		–	–	–25	dB
	MCS7.		–	–	–28	dB
802.11ax	MCS0.		–	–	–5	dB
	MCS1.		–	–	–10	dB
	MCS2		–	–	–13	dB
	MCS3.		–	–	–16	dB
	MCS4.		–	–	–19	dB
	MCS5.		–	–	–22	dB
	MCS6.		–	–	–25	dB
	MCS7.		–	–	–27	dB
	MCS8.		–	–	–30	dB
	MCS9.		–	–	–32	dB
	MCS10.		–	–	–35	dB
	MCS11.		–	–	–35	dB

Parameter	Conditions	Min.	Nom.	Max.	Unit
802.11a/n/ac/ax Frequency	**5 GHz**	4900	–	5845	MHz
Transmit Power					
802.11a	6Mbps	17	19	21	dBm
	54Mbps	14	16	18	dBm

802.11n	HT20, MCS0	17	19	21	dBm
	HT20, MCS7	13	15	17	dBm
	HT40, MCS0	17	19	21	dBm
	HT40, MCS7	13	15	17	dBm
802.11ac	VHT20,MCS0	17	19	21	dBm
	VHT20,MCS8	13	15	17	dBm
	VHT40,MCS0	17	19	21	dBm
	VHT40,MCS9	12	14	16	dBm
	VHT80,MCS0	15	17	19	dBm
	VHT80,MCS9	12	14	16	dBm
802.11ax	HE20,MCS0	17	19	21	dBm
	HE20,MCS9	12	14	16	dBm
	HE40,MCS0	17	19	21	dBm
	HE40,MCS9	12	14	16	dBm
	HE80,MCS0	17	19	21	dBm
	HE80,MCS9	12	14	16	dBm
Spectrum Mask					
802.11a	fc±9MHz	–	–	0	dBr
	fc±11MHz	–	–	–20	dBr
	fc±20MHz	–	–	–28	dBr
	fc±30MHz	–	–	–40	dBr
802.11n	fc±9MHz	–	–	0	dBr
	fc±11MHz	–	–	–20	dBr
	fc±20MHz	–	–	–28	dBr
	fc±30MHz	–	–	–45	dBr
802.11ac (VHT80)	fc±39MHz	–	–	0	dBr
	fc±41MHz	–	–	–20	dBr
	fc±80MHz	–	–	–28	dBr
	fc±120MHz	–	–	–40	dBr
802.11ax (HE80)	fc±39.5MHz	–	–	0	dBr
	fc±40.5MHz	–	–	–20	dBr
	fc±80MHz	–	–	–28	dBr
	fc±120MHz	–	–	–40	dBr
Center Frequency Tolerance					
802.11a/n/ac/ax		–20	–	+20	ppm
EVM (Error Vector Magnitude)*					
802.11a	6Mbps	–	–	–5	dB
	9Mbps	–	–	–8	dB
	12Mbps	–	–	–10	dB
	18Mbps	–	–	–13	dB
	24Mbps	–	–	–16	dB
	36Mbps	–	–	–19	dB
	48Mbps	–	–	–22	dB
	54Mbps	–	–	–25	dB

802.11n	MCS0.	–	–	–5	dB
	MCS1.	–	–	–10	dB
	MCS2	–	–	–13	dB
	MCS3.	–	–	–16	dB
	MCS4.	–	–	–19	dB
	MCS5.	–	–	–22	dB
	MCS6.	–	–	–25	dB
	MCS7.	–	–	–28	dB
802.11ac	MCS0.	–	–	–5	dB
	MCS1.	–	–	–10	dB
	MCS2	–	–	–13	dB
	MCS3.	–	–	–16	dB
	MCS4.	–	–	–19	dB
	MCS5.	–	–	–22	dB
	MCS6.	–	–	–25	dB
	MCS7.	–	–	–27	dB
	MCS8.	–	–	–30	dB
	MCS9.	–	–	–32	dB
802.11ax	MCS0.	–	–	–5	dB
	MCS1.	–	–	–10	dB
	MCS2	–	–	–13	dB
	MCS3.	–	–	–16	dB
	MCS4.	–	–	–19	dB
	MCS5.	–	–	–22	dB
	MCS6.	–	–	–25	dB
	MCS7.	–	–	–27	dB
	MCS8.	–	–	–30	dB
	MCS9.	–	–	–32	dB

3.3.3 Bluetooth RF Specifications

Parameter	Conditions	Minimum	Typical	Maximum	Unit
Frequency Range		2402		2480	MHz
RX Sensitivity	Sensitivity@BER=0.1% for GFSK(1Mbps)		TBD		dBm
	Sensitivity@BER=0.01% for π/4–DQPSK(2Mbps)		TBD		dBm
	Sensitivity@BER=0.01% for 8DPSK (3Mbps)		TBD		dBm
	Sensitivity@PER=30.8% for LE (1Mbps)		–94		dBm
	Sensitivity@PER=30.8% for LE (2Mbps)		–92		dBm
Output Power	BDR		8		dBm
	EDR		8		dBm
	BLE		8		dBm
IEEE802.15.4 RF Specifications					
Frequency Range		2402		2480	MHz
RX Sensitivity	PER<1%		–97		dBm
Output Power	Maximum power output level		8		dBm

3.4 DC Characteristics

3.4.1 Absolute Maximum Ratings

Rating	Symbol	Max	Unit
DC Supply For VCC33	VCC33	3.63	V
DC Supply Voltage For Digital I/O	VDDIO	1.98	V

3.4.2 Recommended Operating Conditions

Parameter	Symbol	Value			Unit
		Minimum	Typical	Maximum	
DC Supply For VCC33	VCC33	3.14	3.3	3.63	V
DC Supply Voltage For Digital I/O	VDDIO	1.62	1.8	1.98	V
Other Digital I/O Pins					
For VDDIO = 1.8V:					
Input High Voltage	VIH	1.2	–	2.1	V
Input Low Voltage	VIL	–0.3	–	0.6	V
Output High Voltage	VOH	1.4	–	2.1	V
Output Low Voltage	VOL	–0.3	–	0.4	V

3.5 Power Sequence

➢ **Power on Sequence**

The following figures show the power on sequence. When VCC33 are 3.3V and CHIP_EN is 1.8V, power on sequence starts. Power on time of VCC33 must be at least 50us earlier than VDDIO when VDDIO is 1.8V.
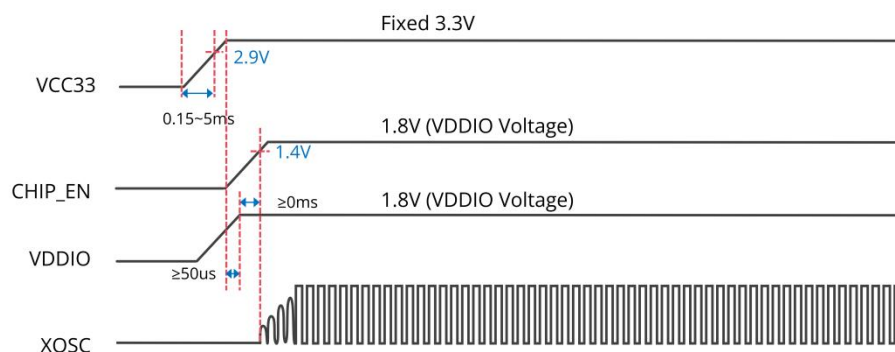
Figure 3. Power on Sequence when DVDDIO is 1.8V of AW65S2-50B1

4. Application, Implementation, and Layout

4.1 Application Diagram
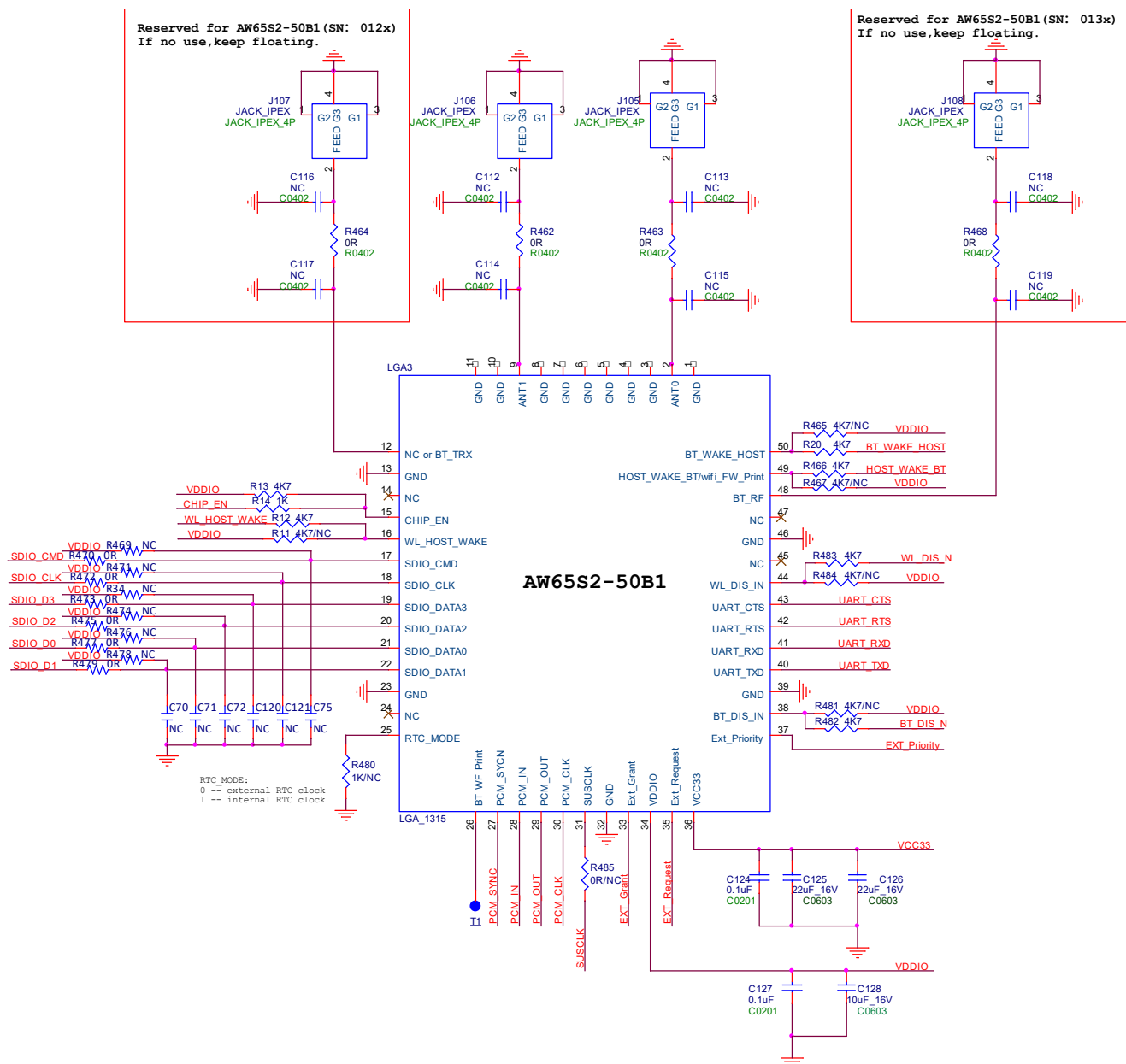
Figure 4. Application Schematic Diagram of AW65S2-50B1

4.2 Layout Guideline

➢ Keep RF traces with 50 Ohm impedance.

➢ The antenna needs to have enough clearance area.

➢ The filter capacitor should be as close as possible to the module.

➢ Do not place strong interference lines under the module.
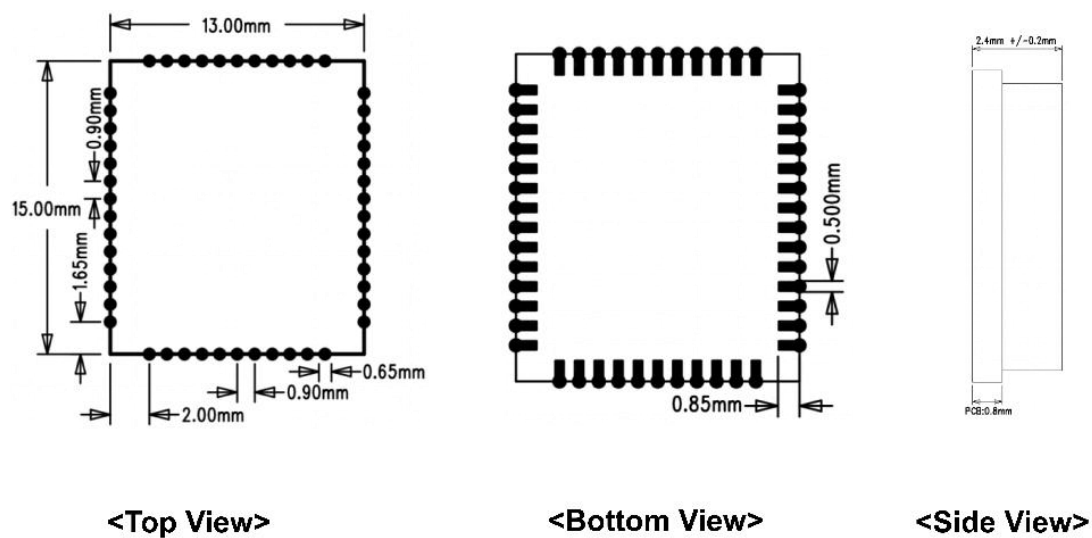
5. Mechanical and Package

5.1 Module Size

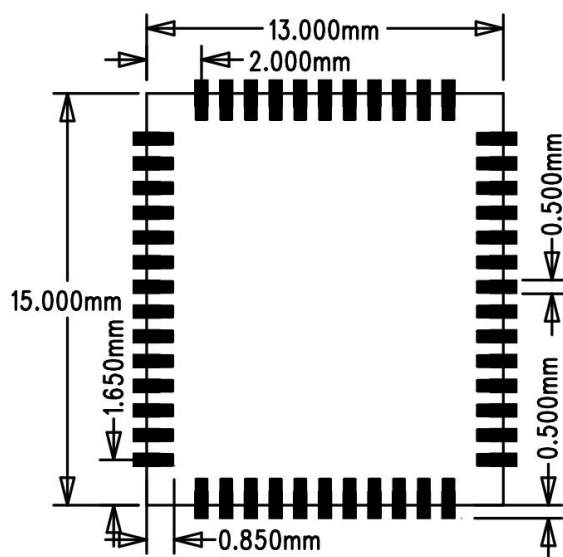**Figure 5. Module Size of AW65S2-50B1**

5.2 Recommended PCB Footprint
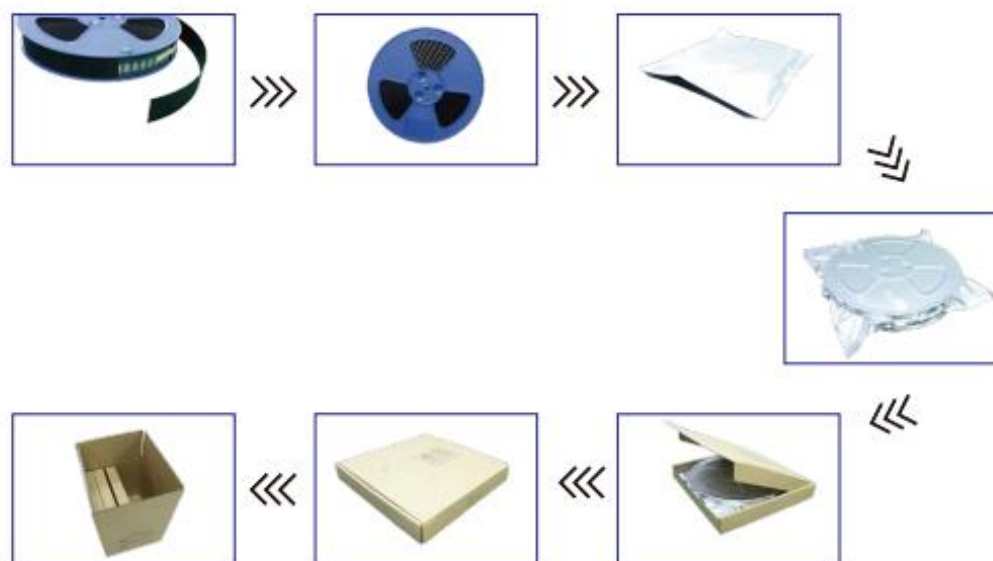

Figure 6. Recommended PCB Footprint of AW65S2-50B1

5.3 Package Information

Figure 7. Brief Packaging Process of AW65S2-50B1

6. Thermal Reflow

➢ Referred to IPC/JEDEC standard.

➢ Peak temperature: <250°C

➢ Number of times: ≤2
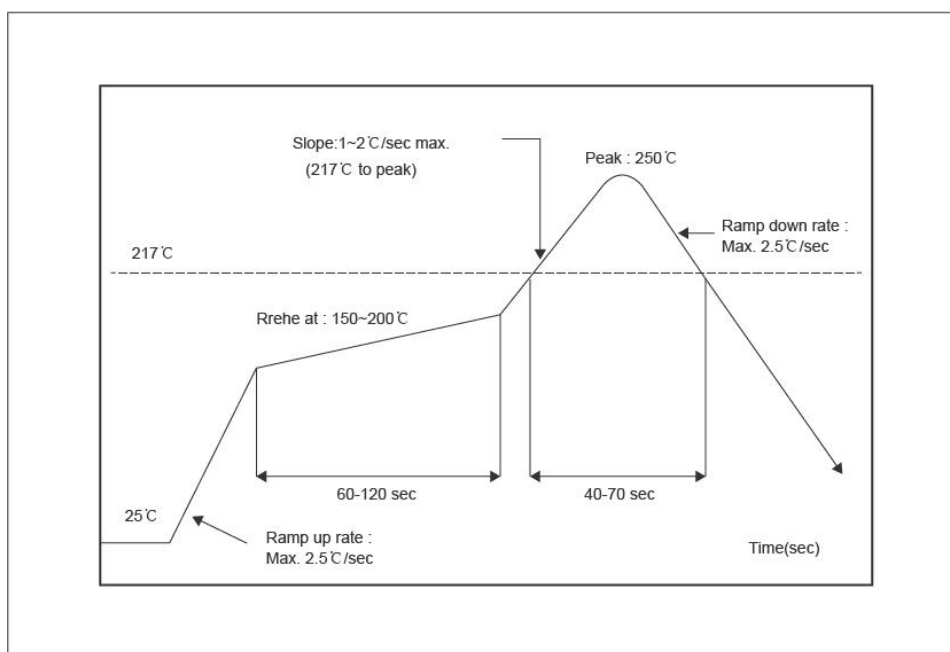
Figure 8. Recommended Reflow for Lead Free Solder

Note: The module is recommended not to go through reflow over twice.

7. Certification Information

None

8. Ordering Information

Part NO.	ANT	Shielding Cover	Remark
AW65S2-50B1	External antenna	Included	

The Key Material List

Item	Part Name	Description	Manufacturer
1	PCB	AW65S2-50B1,FR4,4L	Xusheng
2	Chipset	W265S2-M,QFN68	Amlogic
3	Crystal	2016,40M,15pF	YL
4	Diplexer	1608,2.4G&5G	FTR

9. Revision History

Version	Change Content	Reviser	Date
V1.0	Initial Version	Phil Ye	2024.12.19

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

*RF warning for Mobile device:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID:2BF4V-AW65S2-50B1 ".

Additionally, the following statement should be included on the label and in the final product's user manual:

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interferences, and

(2) this device must accept any interference received, including interference that may cause undesired operation." The module is limited to installation in applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations. A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.This Module is full modular approval, it is limited to OEM installation ONLY. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module.

Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user.

List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 15C(15.247). part 15E(15.407)

Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host

manufacturer's instruction manual. In addition, certain information may also be needed, such as peak

gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT has a Dipole Antenna, and the antenna use a permanently attached antenna which is not replaceable.

Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible

for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);

b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);

c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;

d) Appropriate parts by manufacturer and specifications;

e) Test procedures for design verification; and

f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information:

(1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2BF4V-AW65S2-50B1.

Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")). 2.4G Antenna Gain: 2.53dBi, 5G Antenna Gain: 5150-5250Mhz:1.87dBi 5250-5350Mhz:2.11dBi, 5470-5725Mhz:3.16dBi 5725-5850Mhz : 3.16dBi

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a Dipole Antenna, and the antenna use a permanently attached antenna which is unique.

Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation:The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BF4V-AW65S2-50B1,

Information on test modes and additional testing

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation:The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BF4V-AW65S2-50B1,

requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B

Note EMI Considerations

Note that a host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties For standalone mode, reference the guidance in D04 Module Integration Guide and for simultaneous mode7; see D02 Module Q&A Question 12, which permits the host manufacturer to confirm compliance.

Explanation: The host manufacturers should follow the D04 Module Integration Guide for RF design testing and evaluation to avoid non-compliant EMI limits due to module placement. For standalone mode, refer to D04. For simultaneous mode, see D02 Q&A Question 12 for compliance confirmation.

How to make changes

Since, only Grantees are permitted to make permissive changes, it is recommended that module manufactures provide contact information and some guidance to host providers in the integration instructions if they expect their module will be used differently than granted.

Explanation: Since only Grantees can make permissive changes, module manufacturers should provide contact info and guidance in integration instructions if they expect the module to be used differently than granted.